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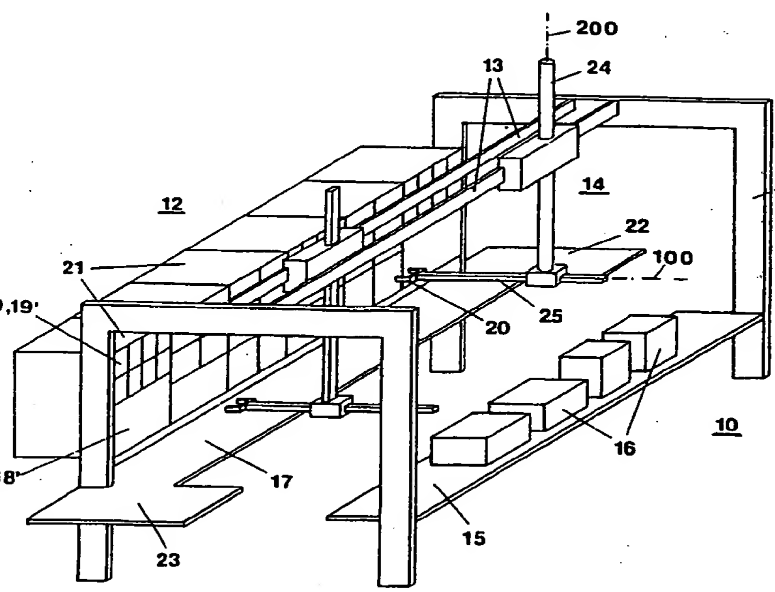

(57) Abstract

A method for the full automation of a laboratory performing analyses wherein a set f elementary operations is established, each performed by a generally known device, and s me suitable sequences of said elementary operations are selected so as to perform the requested preparation cycles and analyses of the tested samples, using an apparatus built by assembling, according to particular rules, a suitable selection of said devices (18, 19) and subsidiary complementary devices (16), all of them interacting with at least one robot (14), under control of a computer, managed by a suitable program, to which said devices and subsidiary devices are connected through suitable interfaces.

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METHOD AND APPARATUS FOR THE FULL AUTOMATION OF A LABORATORY PERFORMING ANALYSES

This invention relates to a method and an apparatus for the full automation of a laboratory performing analyses, particularly, but not exclusively, in the field of the analyses executed for medical purpose.

The analyses executed for medical purpose are notoriously carried out on samples drawn out of patients, for instance blood or urine.

The clinical analyses are performed in special laboratories which are complex and always developing structures, which makes it impossible to frame them into a single operative pattern. From an organizational viewpoint said laboratories may be either independent units or parts of a wider body; they may be structured either as a single unit or be divided in more sections, more or less interconnected; they can perform a variable number of analyses. As for their location they can be placed either in a single room or in more rooms which, in turn, may be either adjoining or distant ones, also in different storeys of the same building or in different buildings. As for their operational capacity they may perform a very different average number of analyses, ranging from one to one hundred or more. As for their equipment they may have a whatever number and whatever assortment of different analysers, of very different operative features and degrees of automation, often chosen according to particular and only partially objective criteria. The situation of every

particular laboratory is partially subjected to contingent causes, linked both to its historical development and to the development of the body which it belongs to; therefore said situation can barely be influenced upon.

Normally said laboratories handle the different materials in a wholly independent way, often processing them according to similar or equal procedures, using many identical devices.
It is known that inside the laboratory said samples are always stored and handled in suitable containers, standardized within each laboratory but not necessarily in all laboratories alike, whereas the samples carried to the reception may be placed in containers of different models and a priori identifiable only for classes of features sometimes relatively hazy too.

It is also known that each sample to be analysed goes always through some successive stages:

- reception: patient's data recording, sample collection, taking on charge and checking of the sample, identification of its container;
- container standardization;
- sample preparation cycle;
- delivery of the prepared samples to the analysers;
- sample analysis, gathering of the results and printing of the reports;
- storing the residual material.

The container standardization and sample preparation stages are at present normally carried out by hand: there are on the

market some devices which can perform some of the necessary operations on a single container, or on either one or many samples, but it is not known the availability of a device performing the complete sequence.

The delivery of the prepared samples to the analysers is normally carried out by hand, but it can certainly be automated with known techniques; nevertheless this stage cannot be framed into a general pattern because it is intrinsically determined by the structure of each laboratory, by its peculiar configuration, by its particular assortment of analysers and their disposition in the laboratory.

The sample analysis can already be implemented, in the majority of instances, by automated devices; the gathering of the results and the drawing up of the reports can already be managed by a computer.

Therefore full automation of a clinical laboratory really means full automation of the container standardization and sample preparation stages.

At present the management of a clinical laboratory is made difficult by many problems which are impossible to solve in a suitable way with the available means.

As for the personnel:
- it's difficult to find skilled operators willing to handle potentially infected materials;
- it's difficult to protect properly the operators against

the infection risk, in particular with the AIDS virus;

- it's difficult to get rid of an operator's errors, consequent to the boredom of an iterative job;

- it's difficult to obtain a real constancy of amounts in the sample preparation, constancy which is quite necessary to achieve precise and reliable end results;

- it's difficult to manage in a simple and effectual way the residual material, so that it may be possible to carry out again, if necessary, in every moment and a straight way one or more of the analyses already performed.

As for the service improvement:

- the necessity to cut sharply the delay between the reception of the samples and the availability of the reports;

- the usefulness to obtain an extension of the working time and even to change it into a non stop service, seven days a week, 24 hours a day, if desired;

- the usefulness to standardize the preliminary operations on the sample;

- the necessity to reduce as far as possible the size of the sample collected from a patient, making it possible that every department of the laboratory gets a sample fit, both as for quality and quantity, for the requested analyses.

The necessity to lower the global running costs and therefore:

- to prolong the utilization time of the premises and the facilities without giving rise to personnel problems;

- to minimize, as already said, the volume of the materials involved in the analyses, also to the purpose to simplifying their disposal;

- to minimize the number of the laboratory's sample preparation centres, each of which entails an increase of the operators' number and of the sets of equipment used by them.

One aim of the present invention is to overcome these drawbacks and to solve the aforementioned problems by providing an apparatus which, starting from the sample received, will prepare it for the requested analysis or analyses, and may possibly perform them, without any direct interference of a human operator.

According to this invention said aims are reached using a procedure explained in the claim 1, which is carried out through an apparatus explained in the claim 3.

Due to the fact that the samples preparation cycles are established as prearranged sequences of elementary operations, each of which is jointly performed by a robot and by a particular device or subsidiary device, placed in an univocally determined position within its range, under control of a computer managed by a suitable program, it is possible:

- to prevent the human operators from handling the samples, so getting rid of the risk both of infection and of errors;
- to decrease drastically the number of specialized operators needed by the laboratory, who are difficult to find out on the market;
- to d crease the number of the sample preparation centres, so lessening the quantity of sets of apparatus needed;
- to prolong the utilization time of the premises and the

facilities without giving rise to personnel problems, so making it possible to extend the working time and cut the delay between the reception of the samples and the availability of the reports;

- to keep a real constancy of amounts in the sample preparation, so achieving precise and reliable end results;

- to standardize the preliminary operations on the sample, so as to be able to minimize the necessary amount of it, since every department of the laboratory gets a sample fit as for quality and quantity for the requested analyses; this fact, for instance in the field of the clinical analysis, makes it possible to minimize the size of the sample collected from the patient; moreover the minimization of the size of the sample makes it possible the minimization of the quantity of treated materials to be disposed of.

Due to the fact that the set of elementary operations comprises at least some of those enumerated in the claim 2, it is possible to carry out all the analyses normally requested on the materials most commonly used in the clinical tests.

Due to the fact that the apparatus is structured like a mosaic of tesserae arrayed frontally on a plane, each holding a particular device, and that the subsidiary devices are placed in an univocally determined position within the range of at least one robot and due to the fact that to each of these elements is biunivocally associated a set of subroutines, it is possible:

- to assemble with the same building blocks equipments of

radically different features, both as for their performances and for their operational capacity, by assembling different assortments of types and numbers of said devices to suit each case;

- to include in said equipment as many devices available in the laboratory as possible, therefore saving on its capital cost and permitting its gradual introduction in the laboratory;

- to update said equipment by introducing in it new elements as soon as they get available on the market and therefore always updating it abreast of the development of the techniques, without being forced to replace the other building elements;

- to provide equipments of different reliability degrees by simply placing a redundant number of tesserae in the mosaic and of subsidiary devices.

Due to the fact that the residual material is stored in a multiple container whose every section holds the sample quantity needed to repeat any of the already performed analyses, it is possible to manage in a simple and effective way the material in stock and repeat the analyses in a straightforward way, if required.

Due to the fact that every tessera in the mosaic is equipped with a manual control in parallel to the central control of the computer, it is possible, when acting for instance on a sample so small that the skill of a human operator is needed, to move the robots to their rest position, disconnect the computer, connect the manual control and perform manually any

desired sequence of operations.

Any specific sample preparation cycle is always a sequence of elementary operations, normally different in every particular case. From an extensive scrutiny of the different particular preparation cycles normally used, it emerges nevertheless that the total number of different elementary operations, which these cycles are composed of, is very small. Therefore it is possible to obtain a general operative pattern, effective for every laboratory.

This invention originates from the acknowledgment that every elementary operation composing the preparation cycles has been conceived either to be performed by a particular device, for instance a centrifugation, or to be carried out using two hands, one of which is always used in a support function, for instance to hold a test tube, and the other performs an operation, for instance either it inserts in said test tube the tip of a dispenser or it draws out either a part of its contents or the whole of it.

Therefore all the elementary operations composing the sample preparation cycles can be carried out by a cooperation of a robot either with some device, for instance a dispenser, or with some subsidiary device, for instance a centrifuge. The robot will perform all the necessary handling; devices and subsidiary devices will carry out the real operations.

All the advantages previously listed can therefore be achieved by using a structure formed by: a holding frame; a

mosaic of tesserae arrayed frontally on a vertical plane; at least a rail, preferably overhead, which at least one robot runs along; at least a support table for the subsidiary devices and preferably a second support table at the foot of said mosaic of devices.

The mosaic of devices is formed by an assemblage of tesserae, both of modular or submodular dimensions, each of which contains a particular device, respectively capable of carrying out either a single operation or a short sequence of single operations, for instance a test tube feeder or a dispenser. Each of said tesserae is equipped with a suitable interface which enables it to exchange messages with a computer controlling its operations and coordinating them with all the other constituent elements of the system.

Said interfaces are electronic circuits, wholly designed with known techniques, converting the inputs to and the outputs from the device in messages coded according to a standard protocol, transmitted through a standard network.

As it is known to those expert in this field, at present there are in use some standard networks which could be used in this equipment too; the choice of one of them will substantially be determined by market considerations.

There are particular cases, for instance if the sample is not sufficient, in which resorting for that specific preparation to the skill of a qualified operator is essential. To avoid to be compelled to keep operational a whole set of manual

devices just to be able to prepare a very small number of samples, it is therefore useful that said equipment may be used also manually; for this purpose every tessera of the mosaic is provided with manual controls and local displays, paralleled to said interface. So it is possible in every moment to stop the automatic operation of the equipment, to disconnect the centralized control, after moving away, for safety, the robot or the robots, and to carry out the necessary preparations.

The tesserae are placed on the wall in such a way to minimize number and length of the movements of the robot, or robots, which carry both the test tubes and the other objects from a tessera to another and from them to the subsidiary devices, so making the performance of the necessary operations as swift as possible. The devices placed in the tesserae of a particular mosaic and the subsidiary devices on the whole must always be such as to be able to carry out all the single operations needed to prepare the samples for all the analyses foreseen in that particular laboratory.

The number of the devices placed in said tesserae and of said subsidiary devices may be suitably increased both to raise the productivity of the equipment, that is making it possible to perform the same operation simultaneously at two, or more, equal tesserae of the mosaic or with two, or more, subsidiary devices, and to increase its reliability, making it possible that in the event of breakdown of any element of the system it may always be substituted by another equal one.

Along the front of the mosaic there runs at least one robot supported by a horizontal rail parallel to the plane of said mosaic; the number of said robots is determined by the desired capacity of the device and may be increased to improve its reliability. To make it easier to use manually said device if required, it is better that said rail be not placed in the range where the human operator must work; this can be achieved by placing the rail high enough, that is using an overhead rail.

If all the devices placed in the tesserae of the mosaic and all the subsidiary devices which altogether form the equipment are provided in such a way that all the operations carried out both to insert and to take out the objects which are to be handled, for instance the test tubes, may be accomplished by performing only movements following horizontal and vertical axes, it is possible to use robots apt to move objects along three axes only, i.e. one vertical axis, one horizontal axis perpendicular to the mosaic plane and an axis of rotation to plus or minus 180 degrees pivoting around the vertical axis previously defined; the latter axis is necessary to load and unload the subsidiary devices, if they are placed on a supporting table lying in front of the mosaic and on the other side of the rail. Obviously, to these three movements there is to be added that one along said rail.

Said robot must be powered by controlled acceleration drives, so as to prevent in every case the transported materials from getting damaged, and must be equipped with a hand embodying

suitable features, apt to handle small but easily damageable loads.

The subsidiary devices are to be placed in univocally determined positions within the working range of the robot, or robots. It's better not to place them at the mosaic foot to prevent the possibility of contamination in the case of rupture, due to failure, during the operations. The best solution is probably to place them on a supporting table parallel to said mosaic and located on the other side of the rail, or rails.

As immediately apparent to the experts in this field, so a shaped equipment allows to carry out, in a simple and swift way, either by using the same supporting structure or only by widening it:
- the replacement of whatever element, be it a device placed in the tessarae of the mosaic or a subsidiary device, with another either equal or equivalent;
- the extension of the very equipment, by adjoining a whatever number of elements;
- its bringing up to date, by taking off whatever number of existing elements and adding any number of new ones.

The computer controlling said equipment must be managed by a program such as to meet two different requirements: to make it perform as swiftly as possible all the sequences of operations determined by the particular requests as they come from the reception, so as to exploit in the best way the configuration of that particular pattern of equipment; to

allow in a very simple way the removal of a whatever number of existing elements, both mosaic tesserae and robots and subsidiary devices, and the addition of a whatever number of new elements, in a very short time and without impairing the system efficiency.

This can be achieved ideally by partitioning said computer into three parts: a control unit determining the strategy to be followed, a section storing the pattern of that particular equipment and a section storing as many groups of subroutines as there are different kinds of elements forming that particular equipment.

For pattern of a particular equipment it is meant: the definition of every tessera of the mosaic, in terms of both its location within said mosaic and of the list of the operations that the device placed in it can carry out; the definition of the position of the rail, or rails, in comparison to said mosaic; the definition of the model of robot, or robots; the definition of the position, of the space orientation of every subsidiary device and of the list of the operations performed by it. Said pattern must be input to the computer at the assembling of each particular equipment and must be updated every time that a change is made to it.

A set of subroutines is biunivocally associated with every single type of equipment element, be it both a device placed in a mosaic tessera or a robot or a subsidiary device. A set comprises at least one subroutine and may include whatever

number of them. The set of subroutines correlated to a given element must be input to the computer when said element is added to the equipment and erased when it is removed.

Every subroutine controls one single operation or a sequence of single operations which can be carried out by said element, be it a device placed in a mosaic tessera or a robot or a subsidiary device, to which it is biunivocally associated. These subroutines may be of very different complexity: from the simpler instance of checking a feeder contents, to a complex sequence of robot movements, to the calculation of the quantity of a given fraction of material contained in a test tube.

The control unit of the computer will establish a global strategy by recording the preparation to be performed on every sample received and splitting each of them into elementary operations, or sequences of elementary operations. Based on the number of devices and subsidiary devices of every kind at its disposal and on the actual position in space of each of them, it will determine the real sequence of operations that is to be carried out and will consequently call and set to action the necessary subroutines.

For instance if it is ordered to the computer to carry out on a given sample a set of analyses for which the preparation of three particular secondary test tubes is required and supposing that the test tube containing said sample has already been centrifuged and therefore it is in a well defined location in the centrifuge, the computer will call

and set to action successively the subroutines controlling the movements of the robot to take the test tube out of the centrifuge and its transfer to the tessera in which is placed the measuring device of the volume of the upper transparent liquid and the measurement of said liquid.

Then the computer checks if said volume is sufficient to prepare the three requested secondary tubes. If not, it will call and set to operation the subroutine controlling the movements of the robot for carrying the test tube to a waiting location. If it is enough, it will call and set to operation successively the subroutines controlling the robot movements carrying the test tube to a dispenser, the suction of the whole volume of upper transparent liquid contained in the test tube, the movements of the robot to carry the test tube to a stated location, to take a particular secondary test tube out of its feeder and carry it to the dispenser, the transfer from the dispenser to said secondary test tube of the correct quantity of liquid necessary to perform the requested analyses, the robot movements for carrying the test tube to the rack of the test machine and its plugging therein. The last three subroutines are called and set to action three times in a sequence, taking every time the secondary test tube out of a generally different feeder and inserting it into a different rack. These operations having been accomplished, the computer calls and sets to action the following subroutines: the robot movements for carrying to the dispenser the container used to store the residual material, the transfer of said material to said container, the robot movements for carrying the container to the sealing

station and its sealing. Then, if necessary, the computer sets to action the subroutine for washing the dispenser, or alternatively, the robot movements to go back to the dispenser, to remove from it the used tip, to carry said tip to a defined position and drop it, to take a new tip out of its feeder, to carry the new tip to the dispenser and insert it thereon.

When devising said strategy the control unit must take into account also the possible particular requests of the operator, for instance an order to prepare a particular sample with absolute priority. Naturally said strategy is to be revised to meet every new request of the reception.

The packaging of the residual material for the archive reserve is at present carried out by transferring all the residual sample into a container, which is later stored in a freezer. This solution has the drawback to compel to thaw the whole reserve in order to use only a fraction of it. Therefore it is better to store the residual material by dividing it into many separate sections, which can be used independently, each of which will hold the quantity of sample necessary to repeat one or more of the analyses which may be requested. The simplest method is to use for this purpose a sterile plastic hose, which is filled with the residual sample by removing the air, and which is then sealed by a tool, applying the required pressure at the required temperature, to partition said hose into many sealed sections separated one another. By cutting the flattened and joined hose parts between any two sections, it is possible to single

out of the freezer and thaw only the amount of sample necessary to perform again the requested analyses, without removing the rest.

Further characteristics and advantages of the invention will become apparent from a reading of the detailed description of a preferred but not exclusive embodiment of an apparatus and method, according to the invention, illustrated only by way of a non-limiting example in the accompanying drawings, wherein

Fig. 1 shows the axonometric outline of a preferred embodiment of an apparatus, according to the present invention; and

Fig. 2 shows a functional schematic simplified block diagram of an embodiment of the computer configuration controlling said apparatus.

Fig. 1 shows the axonometric outline of a particular pattern of apparatus 10. In it a bearing structure 11 supports: a mosaic of tesserae 12 divided into modules 21, six in the figure, each of which holds more tesserae of both modular and submodular (18',19') dimensions, each of which containing a particular device 18 or 19; a supporting table 15 sustains four subsidiary devices 16, for instance centrifuges or mixers; a second supporting table 17, fundamentally foreseen to simplify the manual operations, equipped with two lateral extensions 22 and 23 apt to sustain respectively the containers received and the samples ready to be transferred

to the analysers; two rails 13, placed overhead, along each of which runs a robot 14 provided with a vertical arm 24 which moves vertically and causes a horizontal arm 25 to rotate around its axis 200.

The arm in its turn moves an hand 20 along a horizontal axis 100. To simplify, the computer, the interconnecting network, the interfaces and the manual controls, being all completely featured with known techniques, are not shown in the figure.

As a non limiting instance the fig. 2 shows a functional schematic simplified block diagram of said computer. In it is portrayed a rectangle 26, representing the whole computer, including on its superior right angle a rectangle 28 and below a set of small rectangles 29, twenty in the figure. The rectangle 28 portrays the memory section of the computer storing the pattern of a particular apparatus 10. In this figure it is portrayed in a schematic way an apparatus formed by a mosaic, globally represented with 12, composed of six modular elements, each housing a certain number of tesserae 18' and 19', two robots 14 running along two rails 13 and four subsidiary apparatus 16, wholly similar to the apparatus 10 portrayed in the fig. 1. Each rectangle below represents a set 29 of subroutines 30, including a different number of subroutines in each case. The remaining part of the area of the outer rectangle represents the control unit 27.

It will be immediately apparent to those expert in this field that the proposed apparatus can be adjoined by and cooperate with another, specifically designed for a particular

laboratory, which carries the prepared samples to the analysers. It is also apparent that said function can be achieved, in particular cases, also by lengthening the bearing structure and consequently the rails supporting the robots, using them for this latter function too.

It is also apparent that said apparatus can be placed in a room with a controlled atmosphere, if a particular degree of sterility is required.

It is also clear that the potentiality of the present invention is much wider than that outlined in this text; in particular said apparatus can be used to prepare different samples for different kinds of materials in other fields.

The apparatus and method according to the invention are susceptible to numerous modifications and variations, all of which are within the scope of the inventive concept. All the details may furthermore be replaced with other technically equivalent elements.

In practice, the materials employed, as well as the dimensions, may be any according to the requirements.

Having thus described one particular embodiment of the invention, various alterations, modifications, and improvements will readily occur to those skilled in the art. Such alterations, modifications, and improvements as are made obvious by this disclosure are intended to be part of this disclosure though not expressly stated herein, and are

intended to be within the spirit and scope of the invention.

Accordingly, the foregoing description is by way of example only and is not intended as limiting. The invention is limited only as defined in the following claims and the equivalents thereto.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

CLAIMS

1. Method for the full automation of an analysis laboratory, characterized in that it comprises the steps of:

a) providing a set of elementary operations, each of which is apt to be performed by means of normally already known automated devices, said set of elementary operations including all those which, suitably selected, combined and executed in pre-established sequence case by case, make it possible to carry out all the preparation and analysis cycles planned in the laboratory;

b) for each of said automated devices providing a location in a univocally determined position, peculiar to each given unit, and placed within the range of at least one robot apt to transfer to and from each of the said devices the samples on which the sequence of elementary operations planned for each preparation and analysis cycle is carried out;

c) prearranging a set of subsidiary devices complementary to said devices in a univocally stated position within the range of the at least one robot;

d) implementing an univocal procedure, through selection, combination and sequential execution of said elementary operations, and pre-established for each kind of sample preparation and analysis;

e) by means of a computer, supplied with a a suitable control program and connected through suitable interfaces to said

devices and subsidiary devices and the at least one robot, the orders planned in the program necessary for the sequential handling of the samples to and from each of the devices and subsidiary devices are imparted to said robot, and each time to said elements, devices and subsidiary devices and the at least one robot are imparted, through said interfaces, the orders necessary to perform the respective elementary operations planned in the preparation or analysis cycle wanted each time and for the gathering of the results.

2. Method according to the claim 1, in particular for clinical analyses on samples collected from a patient, characterized in that the set of elementary operations comprises at least some of the following steps:

- container identification;
- container standardization;
- stirring of the material;
- centrifugation;,
- assessment of the actually available quantity of the sample;
- dispensing, dilution, concentration, filtration and dialysis of the sample;
- slide preparation;
- storage of the residual material in the archive;
- possible washing of the used implements;
- necessary auxiliary operations (taking a test tube or a tip out of a feeder, etc.).

3. Apparatus for performing the method, according to claims 1 and 2, characterized in that it comprises:

a mosaic (12) of tesserae (18',19'), each located in a univocally determined position within the range of at least one robot and each containing a device (18,19), and by suitable subsidiary devices (16) also within the range of the at least one robot in a univocally determined location, said devices (18,19) and subsidiary devices (16) being apt on the whole to perform all the elementary operations planned for each sample preparation or analysis carried out by the laboratory;

at least one robot (14), adapted to transfer the samples in sequence from a device (18,19) to another one and to or from the subsidiary devices (16) to perform the sequences of elementary operations of which every preparation or analysis cycle carried out in the laboratory is composed;

a computer (26) for the programmed control of said sequences of elementary operations as required each time;

an interface between each of said elements, both devices (18,19) and subsidiary devices (16) and robots (14), and the computer (26) and means of selection to choose the wanted preparation or analysis cycle.

4. Apparatus according to claim 3 characterized in that the mosaic (12) of tesserae (18',19') is arrayed frontally on a vertical plane surface.

5. Apparatus, according to claims 3 and 4 characterized in that the at least one robot (14) is apt to move objects at

least along a horizontal axis (100) and a vertical axis (200), placed in a vertical plane perpendicular to the plane of said mosaic (12), to make them rotate around said vertical axis (200) and to move them along a horizontal rail (13) parallel to the plane of said mosaic (12) and preferably placed overhead, every robot being able to cooperate with the devices (18',19), placed in the tesserae (18',19') of said mosaic (12), and said subsidiary devices (16), situated in univocally determined positions within its range, for the execution of the planned sequences of operations according to said method, under control of the computer (26).

6. Apparatus according to claims 3 and 4, characterized in that to every single element (18,19;14;16) of the apparatus (10) is biunivocally associated a set (29) of subroutines (30), each set (29) including always at least one subroutine (30), and that the set of subroutines (29) associated with a given element (18,19;14,16) is input to the computer when the same element is included in the apparatus (10) and is erased when it is removed.

7. Apparatus according to claim 6 characterized in that every single element (18,19;14;16) can perform either a single operation, controlled by a subroutine (30), or a sequence of single operations (29), controlled by a set (29) of subroutines (30), which said element is biunivocally associated to.

8. Apparatus for the full automation of an analysis laboratory according to one of the previous claims in which

the computer (26) includes:

a control unit (27) implementing the global strategies to fulfil the carrying out of the preparations or analyses requested for each sample taken on charge, splitting each of them into single operations, or sets of single operations, and determining, on the ground of the number of pieces of every kind of element (18,19;14;16) at its disposal and the spatial position of each of said elements, the real sequence of operations which is to be carried out and calling and setting to work accordingly the necessary subroutines (30);

a memory section (28) which stores the pattern of the particular apparatus (10), said pattern being input to the computer (26) at the assembling of every apparatus (10) and being updated at every possible change of it;

as many sets (29) of subroutines (30) as there are different kinds of elements (18,19;14;16) composing said particular apparatus (10).

9. Method according to claims 1 and 2, characterized in that the elementary operation to store the residual material in the archive is carried out by putting the residual part of the sample in a container without air, consisting of a sterile plastic hose which may be divided, after its filling, into many adjoining sections divided by sealings obtained by a suitable apparatus applying the required pressure at the required temperature, at suitable distance along the filled part of said hose, each of said sections holding the quantity

of sample sufficient to possibly perform over again one or more of the analyses, said section of archive being capable of being used in a totally independent way from the rest of said archive.

10. Apparatus according to claims 3 or 4 characterized in that every tessera (18',19') of said mosaic (12) is provided with manual controls, paralleled to the centralized ones of the computer (26), so that the device (18,19) placed into said tessera (18',19') may be used manually after the disconnection of said centralized control.

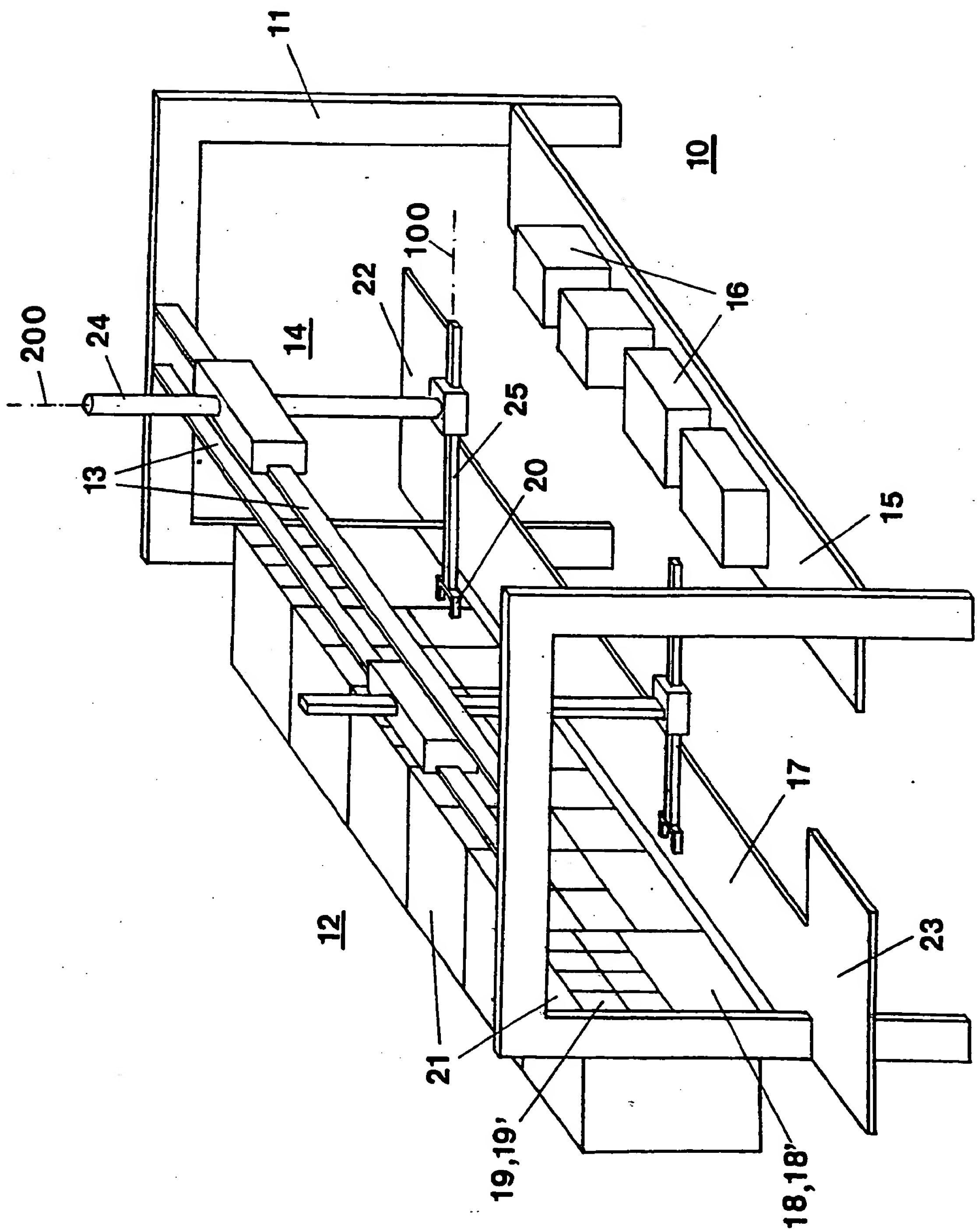

Fig. 1

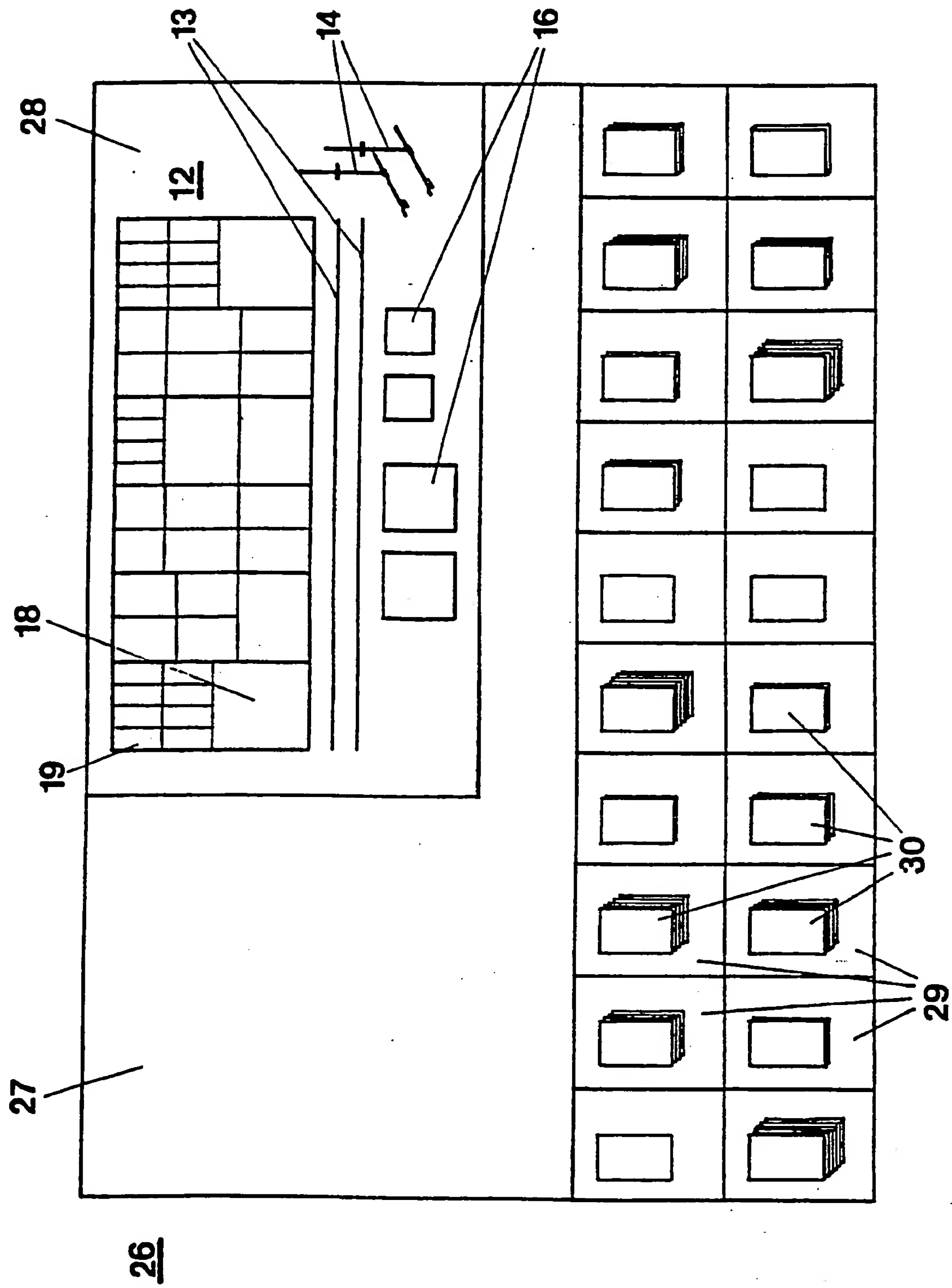

Fig. 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/EP 93/00103

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 G01N35/00

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	G01N ; B01L

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
X	ANALYTICAL CHEMISTRY vol. 62, no. 1, January 1990, WASHINGTON DC pages 29A - 34A , XP000114384 NEWMAN 'SEND IN THE ROBOTS'	1-5
Y	see page 29A, right column, paragraph 2 - page 30A, middle column, paragraph 1	9
A	see page 32A, right column, paragraph 2 - page 34A, right column, last paragraph; figures 1,6 ---	6-8,10
X	EP,A,0 251 441 (ZYMARK CORPORATION) 7 January 1988 see page 4, line 4 - page 8, line 5; claim 1 ---	1-3,6-8

-/--

° Special categories of cited documents : [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
18 MAY 1993	09. 06. 93
International Searching Authority	Signature of Authorized Officer
EUROPEAN PATENT OFFICE	MILLS J.

International Application No PCT/EP 93/00103

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y	US,A,3 579 303 (PICKERING) 18 May 1971 see column 2, line 20 - line 36; claims 1,2; figures 4-11	9
X	WO,A,9 003 834 (MEDICAL AUTOMATION SPECIALISTS) 19 April 1990 see abstract; claim 1; figure 1	1-3
A	US,A,3 976 028 (HOWELLS & NEWMAN) 24 August 1976 see column 1, line 4 - line 37; figure 8	4,5

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

EP 9300103
SA 69892

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 18/05/93

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0251441	07-01-88	JP-A- 62292373	19-12-87
		US-A- 4835711	30-05-89
US-A-3579303	18-05-71	US-A- 3561186	09-02-71
WO-A-9003834	19-04-90	US-A- 4927545	22-05-90
		CA-A- 2000240	06-04-90
		US-A- 4962041	09-10-90
US-A-3976028	24-08-76	GB-A- 1453226	20-10-76

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82